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ZENKO, Zachary, KAHN, Rachel, BERMAN, Catherine, HUTCHINSON, Jasmin and JONES, Leighton <http://orcid.org/0000-0002-7899-4119>

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Do exercisers maximize their pleasure by default? Using prompts to enhance the affective experience of exercise

Zachary Zenko[1*], Rachel M. Kahn[2], Catherine J. Berman[2], Jasmin Hutchinson[3], and Leighton Jones[4]

[1]Department of Kinesiology, California State University, Bakersfield

[2]Center for Advanced Hindsight, Duke University

[3]Department of Exercise Science and Sport Studies, Springfield College

[4]Academy of Sport and Physical Activity, Sheffield Hallam University

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*Address correspondence to:

Zachary Zenko, Ph.D.
Department of Kinesiology
Mail Stop: 22 EDUC
California State University, Bakersfield
9001 Stockdale Highway
Bakersfield, CA 93311
zzenko@csub.edu
(661) 654-2799

Abstract

Researchers and practitioners are increasingly recognizing the importance of maximizing pleasure during exercise in order to promote exercise behavior. Self-selected intensity exercise can increase pleasure during exercise, but it is not yet known whether participants maximize pleasure during self-selected intensity exercise by default. We hypothesized that prompting participants to maximize pleasure and enjoyment would result in more positive affective valence during (H1) and after (H2) exercise, greater remembered pleasure following exercise (H3), and greater enjoyment of exercise (H4). In this within-subjects experiment, 39 inactive adults completed two 10-min stationary cycling sessions at a self-selected intensity. During the experimental condition, participants were reminded (five times during the 10-min session) to maximize pleasure and enjoyment, and that they could change the intensity if they wanted. Affective valence, heart rate, and ratings of perceived exertion were measured every two minutes during exercise. Affective valence, enjoyment, and remembered pleasure were measured after each exercise session. The control condition was identical, except no prompts were provided. Each hypothesis was supported ($p < .05$). Prompting participants to maximize their pleasure and enjoyment resulted in increased pleasure as the exercise session progressed. After receiving prompts, participants also reported more positive post-exercise affective valence and rated the session as more pleasant and enjoyable. These results suggest that participants do not maximize pleasure and enjoyment by default (i.e., in the absence of reminders to do so). Researchers can build on these results to determine the mechanisms and whether prompting exercisers to maximize pleasure and enjoyment can promote exercise behavior.

Keywords: affective valence, affective responses, prompting, self-selected intensity

Most adults in Western countries, including the USA (Troiano et al., 2008; Tudor-Locke, Brashear, Johnson, & Katzmarzyk, 2010) and Canada (Colley et al., 2011; Liu, Wade, Faught, & Hay, 2008) are insufficiently active. The societal burden of such inactivity has also been well documented (Kohl, et al., 2012; Lee et al., 2012). Thus, innovative strategies for improving rates of physical activity behavior are needed.

Hedonic theory, or the theory of psychological hedonism, suggests that people repeat activities that feel pleasurable and avoid activities that elicit displeasure (Ekkekakis, 2009). Applied to the context of exercise, hedonic theory suggests that maximizing pleasure experienced during exercise would enhance future exercise behavior (e.g., Ekkekakis, Vazou, Bixby, & Georgiadis, 2016). Indeed, mounting evidence suggests that the degree of pleasure experienced during exercise is meaningfully predictive of future exercise behavior (for review see Rhodes & Kates, 2015; Williams, Dunsiger, Jennings, & Marcus, 2012). Theorists have argued that the pleasure experienced during exercise can influence automatic associations with exercise, such as the tendency to automatically approach or avoid physical activity (Ekkekakis & Dafermos, 2012; Ekkekakis & Zenko, 2016) and that these automatic associations influence behavior (Brand & Ekkekakis, 2018). Therefore, empirical evidence and theoretical justifications exist for maximizing the pleasure of exercise in an effort to promote long-term adherence.

Behavioral decisions are often based on predictions of the hedonic consequences of future events; such predictions draw heavily upon the retrospective evaluation of the pain or pleasure associated with past episodes, a concept known as *remembered utility* in the field of behavioral economics (Kahneman et al., 1997; Oliver, 2016). Consequently, maximizing the level of pleasure and enjoyment associated with an exercise experience may enhance future exercise behavior.

Evidence suggests that the memory of an experience is not simply determined by the average level of pleasure or displeasure felt during the experience, but by certain highly influential moments of an experience, such as the “peak” (highest or lowest levels of pleasure or displeasure) and the end of an experience (Kahneman, Wakker, & Sarin, 1997; Redelmeier & Kahneman, 1996; Schreiber & Kahneman, 2000; Zenko, Ekkekakis, & Ariely, 2016). Thus, moment-to-moment recordings of pleasure might not accurately reflect how an exercise experience registers in memory and influences a person’s predictions of how pleasurable or unpleasant future exercise will be. Instead, asking participants to report how pleasurable they remember the exercise session to be may be important for predicting future exercise behavior.

During self-selected or self-paced exercise, the exercise intensity is determined by the exerciser – not prescribed by another person (e.g., personal trainer, researcher, practitioner). Previous reviews have indicated that, with some exceptions, most individuals self-select intensities that are associated with physiological benefits (Ekkekakis, 2009). Self-selected exercise intensity has been linked to enhanced autonomy, interest/enjoyment, and perceived choice (Hutchinson et al., 2018; Vazou-Ekkekakis & Ekkekakis, 2009). Further, exercise programs consisting of self-selected exercise intensities have been shown to result in greater exercise adherence and greater energy expenditure, compared to prescribed moderate-intensity exercise programs (Williams et al., 2015). The greater exercise adherence is at least partly due to more positive affective responses to self-selected exercise (Williams et al., 2016).

Although self-selected intensities can result in positive affective responses to exercise (Haile, Goss, Andreacci, Nagle, & Robertson, 2019; Sheppard & Parfitt, 2008), people may not optimize their exercise for maximum pleasure by default. One reason is that people may not intuitively understand how to increase pleasure experience during exercise. Even when intensities are not imposed, participants may not intuit the relation between exercise intensity and pleasure that has been reported in previous research (Ekkekakis, Parfitt, & Petruzzello, 2011). Further, oft-repeated phrases such as “no pain, no gain” and “go for the burn” may have influenced the attitudes and beliefs of the general public (Slotterback, Leeman, & Oakes, 2006). In other words, the general public may have the goal of “burning calories” during exercise but not maximizing pleasure. One of the goals of this study was to determine if people optimize their exercise experience for pleasure by default.

Reminders or prompts at behavioral decision points (e.g., deciding whether or not to go to the gym at all, or deciding to engage in vigorous- vs. low-intensity exercise once at the gym) could not only prompt people to be more active (Russell & Hutchinson, 2000), but also help them maximize their pleasure and enjoyment when doing so. Reminders or prompts at decision points have been found to yield improvements in behavior in the medical (e.g., Shojania et al., 2010; Tang, LaRosa, Newcomb, & Gorden, 1999), financial (e.g., Karlan, McConnell, Mullainathan, & Zinman, 2016), dietary (e.g., Papies & Veling, 2013), and physical activity (e.g., Schwerdtfeger, Schmitz, & Warken, 2012) domains.

Using prompts to maximize pleasure and enjoyment may make the goal of exercising for pleasure and enjoyment more salient than it would be by default, in a situation without prompts. Research shows the importance of incorporating periodic or persistent reminders to increase goal salience (e.g., Fry & Neff, 2009). A relevant example might be Thaler and Sunstein's (2008) concept of “nudge” which describes attempts to influence behavior in a predictable way but without restricting choice. In health care settings, nudges can be designed to remind, guide, or motivate behavior (Patel et al., 2018). In the present study, we manipulated the salience of maximizing pleasure and enjoyment to determine if it would have any effect on the affective experience of exercise.

The purpose of the current study was to determine (i) if people optimize their exercise experience for pleasure by default and (ii) if prompts to maximize pleasure and enjoyment during exercise could result in greater experienced pleasure during and after exercise, greater remembered pleasure about the exercise session, and more enjoyment of the exercise session. We hypothesized that prompting participants to maximize pleasure and enjoyment would result in more positive affective responses during exercise (H1), higher postexercise affective valence (H2), greater remembered pleasure of exercise (H3), and more remembered enjoyment of exercise (H4).

Prior reviews indicate that at lower exercise intensities, especially below the ventilatory threshold, most people experience pleasure; in contrast, higher exercise intensities (above the ventilatory threshold) are associated with reduced levels of pleasure (Ekkekakis et al., 2011). Therefore, this study was also designed to explore whether participants would also decrease self-selected exercise intensity in response to reminders about maximizing their pleasure. Decreases in self-selected exercise intensity might help explain underlying mechanisms for increases in pleasure and enjoyment. As this analysis was exploratory in nature, no *a priori* hypotheses were set in relation to the intensity-related variables of heart rate (HR) and ratings of perceived exertion (RPE).

Methods

Recruitment and Participants

Recruitment began after ethics approval by an institutional review board. A power analysis indicated that to achieve 80% statistical power with a Type 1 error rate of 5% (twosided), anticipating a medium effect size (*d* = .5), at least 34 participants would be required for a paired-samples *t*-test. To account for potential dropout or participant deletion, the sample size was inflated by 20% to 41. Therefore, we aimed to recruit 41 participants to the present study. A pre-study demographics questionnaire was sent to participants via email to obtain information about gender, age, body mass index (BMI), race and ethnicity, and status as a current student at the university.

Potential participants were recruited using an electronic participant recruitment platform (SONA system) of a large university on the East Coast of the United States, which includes members of the university and local community. Participants were screened for study eligibility based on two criteria. First, we specifically recruited insufficiently active participants to ensure that the study findings would be applicable to populations in particular need of novel intervention strategies. Participants were asked, “How many minutes of moderate-to-vigorous exercise do you usually obtain per week?” and were eligible if they obtained fewer than 60 minutes of moderate-to-vigorous exercise per week, to ensure that they were not meeting the physical activity guidelines (Garber et al., 2011). Second, participants completed the Physical Activity Readiness Questionnaire (PAR-Q; Adams, 1999) to assess whether it was safe to engage in a physical fitness task; any participant who answered affirmatively to any of the PAR-Q questions was excluded from the study. Eligible participants then scheduled two laboratory visits.

In total, 121 people completed the screening form. Four people were excluded due to affirmative answers on the PAR-Q, 28 were excluded because they reported 60 or more minutes of moderate-to-vigorous exercise per week, and 48 were eligible but did not schedule laboratory visits. Forty-one participants consented and attended at least one laboratory visit. Of these participants, 85.4% completed the prestudy demographics questionnaire and reported the following demographics: 63.6% women, 36.4% men; age: 32 ± 10 years; BMI: 27.37 ± 9.31 kg·m^{-2}; 30.3% White, 27.3% Black or African American, 21.2% Asian, 15.2% Multiracial, 6.1% Latino; 39.4% students. A total of 39 participants completed the study.

Measures

During-exercise measures.

During-exercise affective valence. Affective valence was conceptualized as a bipolar dimension ranging from pleasure to displeasure (Russell, 1980). Affective valence was measured at baseline and during exercise using the Feeling Scale (FS; Hardy & Rejeski, 1989). The FS is a single-item, 11-point, bipolar rating scale that ranges from -5 (Very Bad) to +5 (Very Good) with zero serving as a neutral point. The FS allows affective valence to be assessed repeatedly during exercise for strong temporal resolution yet minimal participant burden. Concurrent validity data have been reported by Hardy and Rejeski (1989).

Heart rate. A heart rate (HR) monitor was worn around the chest to continuously measure heart rate during exercise (Polar, Kempele, Finland). Heart rate was quantified as a percentage of age-predicted maximum heart rate (APMHR; 220-age in years). Heart rate was recorded using the Polar Beat app and participants could not see their heart rate before, during, or after exercise.

Perceived exertion. Ratings of perceived exertion were assessed using Borg's (1998) RPE scale. The scale ranges from 6 (no exertion at all) to 20 (maximal exertion). RPE has correlated with several indices of physiological exertion, including ventilation and lactate accumulation (Chen, Fan, & Moe, 2002).

Postexercise measures.

Postexercise affective valence. The Feeling Scale (FS) was administered two minutes following exercise to assess self-reported pleasure following the exercise session. Practical time constraints in the laboratory, as well as the theoretical consideration that postexercise affective valence has not been linked with future exercise behavior (Rhodes & Kates, 2015), resulted in only one measurement of postexercise affective valence.

Remembered enjoyment. Enjoyment of exercise was assessed using the Physical Activity Enjoyment Scale (PACES; Kendzierski & DeCarlo, 1991). Respondents were asked, "Rate how you feel at the moment about the physical activity you have been doing." The PACES consists of 18 bipolar items with verbal anchors at both ends of the 7-point scale (with "4" as a midpoint). Internal consistency of the PACES in the present sample was high following both exercise sessions (Cronbach's $\alpha = .92, .92$).

Remembered pleasure. Remembered pleasure was assessed following exercise. Using a computer monitor, an on-screen bipolar visual analog scale, with values from 0 to 100, was shown to participants with the question "How did you feel during today's exercise session?" Verbal anchors (ranging from "It was a very negative experience" to "It was a very positive experience") were provided at the extremes of the scale. Participants could move the slider to any point of the scale but were not shown the numerical values associated with the position or either of the verbal anchors. This measure was chosen in order to minimize common-method variance by using a different scale than the FS. Remembered pleasure has been assessed similarly in previous investigations (e.g., Zenko, Ekkekakis, & Ariely, 2016).

Procedures

Laboratory visits. Each participant completed two laboratory visits that were scheduled one week apart at the same time of day and on the same day of the week, to account for potential diurnal variation in the dependent variables. Participants provided informed consent at the beginning of their first laboratory visit. The two laboratory visits each consisted of a 10-min cycle bout completed under two conditions (experimental and control) with an order that was randomly assigned.

Prior to the start of exercise, each participant was fitted with a heart rate monitor. Standardized instructions for the FS and RPE were read to participants, followed by an opportunity to ask questions. In both conditions, all participants exercised at a self-selected intensity in a laboratory setting for 10 minutes on a cycle ergometer (Schwinn 170 Upright Bike, Shwinn, Vancouver, WA, USA). There was no designated warm-up or cool-down to avoid implicitly or explicitly suggesting reduced intensities and to allow participants to choose their own intensity without restrictions. Participants received instructions on how to change ergometer resistance using the up and down arrows on the ergometer control panel. The display screen, which showed ergometer resistance, was hidden from participant view. The laboratory was free from distraction and participants exercised in the presence of one researcher. The FS was administered one minute prior to exercise, every two minutes during exercise, and two minutes postexercise. HR and RPE were measured every two minutes during exercise (i.e., minutes 1:45, 3:45, 5:45, 7:45, and 9:45). The measurements were taken within the last 15 seconds of each two-minute interval to ensure that data were collected while participants were still exercising. Following the exercise bout, participants sat quietly for five minutes prior to completing a questionnaire with measures of remembered enjoyment (PACES) and remembered pleasure.

Conditions. The conditions differed based on the instructions given immediately before exercising and whether additional prompts to maximize pleasure were provided during exercise:

Control condition. A researcher read the following instructions to participants in the control condition prior to exercising:

> For today's exercise session, you will be exercising on a bike for 10 minutes. I'll be asking you questions about how you feel and how hard you perceive the work to be. I'll also be measuring your heart rate. The exercise intensity that you choose is up to you. Do you have any questions?

Participants were able to change their intensity at will, but no reminder was given.

Prompt condition. In the prompt condition, the instructions were modified to remind participants that they could change their intensity and maximize their pleasure:

> For today's exercise session, you will be exercising on a bike for 10 minutes. I'll be asking you questions about how you feel and how hard you perceive the work to be. I'll also be measuring your heart rate. The exercise intensity that you choose is up to you.
>
> Sometimes people feel most pleasant when working harder, and sometimes people feel most pleasant when exercising at a lower intensity. Other times, people feel best when changing their intensities. Today, I want you to focus on maximizing your pleasure. You'll be reminded throughout the exercise session to refocus on your exercise intensity and make sure that it makes you feel the most pleasant imaginable. If it requires changing the intensity, then you should make an adjustment to maximize your pleasure. Do you have any questions?

As in the Control condition, participants could self-select and change the exercise intensity at will. However, a simple prompt was given after every measurement of HR, FS, and RPE. Participants were told, "Remember to maximize your pleasure and enjoyment. You may change the exercise intensity if you wish."

Data Screening and Statistical Analysis

To test H1, changes in affective valence (i.e., FS ratings) were assessed using a 2 (condition) x 6 (time) repeated-measures ANOVA. The six time points were the pre-exercise measure and the five during-exercise measurements. Differences in postexercise affective valence (H2), remembered pleasure (H3), and remembered enjoyment (H4) were assessed using paired *t*-tests. To explore potential causal mechanisms, differences in HR were assessed using a 2 (condition) by 6 (time) repeated-measures ANOVA. Pre-exercise HR and HR at each of the five during-exercise measurements were analyzed. Likewise, a 2 (condition) x 5 (time) repeated-measures ANOVA was used to assess differences in RPE, using the five during-exercise measurements.

Data were inspected for parametric assumptions using visual inspection of histograms. Affective data, heart rate, and perceived exertion were screened for outliers using standardized *z*-scores ($z > \pm 3.29$; Bird, Karageorghis, Baker, & Brookes, 2019; Tabachnick & Fidell, 2013). One participant presented an abnormally low HR during minute 4 of the Prompt condition ($z = -4.06$), likely due to temporary signal disruption or equipment displacement. This participant's data was eliminated from subsequent analyses involving HR, as is recommended in the case of error outliers (Leys, Delacre, Mora, Lakens, & Ley, 2019). Results and conclusions were similar regardless of inclusion or exclusion. A different participant reported extremely low perceived exertion during minute 4 of the Control condition ($z = -3.32$), but this was likely due to inherent measurement error of subjective reports, and the participant's responses were consistent across time. Thus, this participant's data were retained in the analyses. Again, results and conclusions were similar regardless of inclusion or exclusion. In all cases, violations of the sphericity assumption were corrected using the Greenhouse-Geisser correction. Follow-up tests were performed with paired *t*-tests. When the assumptions of paired *t*-tests were violated, nonparametric alternatives are additionally reported to assist in interpretation. Means and standard deviations for all variables and each condition are presented in Table 1.

Results

Affective valence. A repeated-measures ANOVA (2 [condition] x 6 [time]) with affective valence pre- and during-exercise as a dependent variable indicated no significant effect of condition, $F(1, 38) = 3.10$, $p = .086$, $\eta_p^2 = .08$, and no significant effect of time, $F(2.82, 107.32) = 0.73$, $p = .530$, $\eta_p^2 = .02$. There was, however, a significant interaction between condition and time, $F(3.17, 120.34) = 3.21$, $p = .023$, $\eta_p^2 = .08$, such that affective responses in the Prompt condition became more positive as time progressed. Affective valence data is displayed in Table 1 and Figure 1.

Follow-up analyses using paired *t*-tests to compare affective valence between conditions indicated that differences in affective valence began to emerge during minute six (see Figure 1). Only the differences during minutes 6, 8, and 10 approached or reached significance (*t*s(38) = -.314, .200, 1.04, 3.01, 1.97, and 2.11, respectively; *ps* = .755, .843, .303, .005, .056, and .042, respectively; *d*s = .05, .03, .16, .48, .32, and .34, respectively). Small-to-medium differences (Cohen, 1988) were apparent in minutes 6, 8, and 10 (*d*s = .32 - .48).

Postexercise affective valence. Affective valence was significantly higher following the Prompt condition, compared to the Control condition (Table 1; $t(38) = 2.25$ $p = .030$, $d = .36$). Because these data were nonnormal, a Wilcoxon signed-rank test was also used and demonstrated that affective valence was significantly higher following the Prompt condition, compared to the Control condition, showing agreement with the parametric test ($Z = 2.125$, $p = .034$).

Remembered enjoyment. Enjoyment was significantly greater following the Prompt condition than the Control condition, (Table 1; $t(38) = 2.38$, $p = .023$, $d = .38$).

Remembered pleasure. Remembered pleasure was significantly more positive following the Prompt condition than the Control condition (Table 1; $t(15) = 2.57$, $p = .022$, $d = .64$). Notably, less than half of the sample responded to the measure of remembered pleasure, indicating that they may not have fully understood how to respond to the on-screen slider.

Heart rate. The repeated-measures ANOVA (2 [condition] x 6 [time]) with HR pre- and during-exercise as a dependent variable indicated no significant effect of condition, $F(1, 37) = 1.02$, $p = .319$, $\eta_p^2 = .03$, a significant effect of time, $F(1.60, 59.32) = 127.22$, $p < .001$, $\eta_p^2 = .78$, and no significant interaction between condition and time, $F(2.85, 105.29) = 0.57$, $p = .630$, $\eta_p^2 = .02$. Analysis of within-subject contrasts indicated that the quadratic change in HR over time explained the most variance ($\eta_p^2 = .83$). HR data are displayed in Table 1 and Figure 2. Mean HR during the Prompt condition was 66.75% of APMHR. During the Control condition, HR averaged 68.17% APMHR. Both of these are within the range recommended by the American College of Sports Medicine for moderate-intensity physical activity (Garber et al., 2011).

Perceived exertion. The repeated-measures ANOVA (2 [condition] x 5 [time]) with RPE as a dependent variable indicated no significant effect of condition, $F(1, 38) = 1.60$, $p = .214$, $\eta_p^2 = .04$, a significant effect of time, $F(2.25, 30.19) = 10.94$, $p < .001$, $\eta_p^2 = .224$, and no significant interaction between condition and time, $F(2.08, 5.75) = 2.20$, $p = .116$, $\eta_p^2 = .06$. Analysis of within-subject contrasts indicated that the linear change in RPE over time explained the most variance ($\eta_p^2 = .28$). RPE data are displayed in Table 1 and Figure 3.

Discussion

This study was designed to examine whether prompts to maximize pleasure and enjoyment during exercise would enhance affective responses to exercise. Forty-one insufficiently active participants were recruited and 39 completed the study. The participants completed two exercise sessions to determine if a session with prompts to maximize pleasure, increase enjoyment, and change the intensity "if [they] wish[ed]" would result in differences in affective valence, remembered pleasure, enjoyment, and postexercise pleasure. We hypothesized that affective valence during and following exercise, remembered pleasure, and remembered enjoyment would be enhanced by prompts to maximize pleasure.

Our hypotheses were supported. Participants experienced more pleasure over time during the Prompt condition compared to the Control condition (H1). They also experienced greater postexercise pleasure following the Prompt condition, compared to the Control condition (H2). In addition, participants remembered the Prompt condition as more pleasurable (H3) and more enjoyable (H4) than the Control condition. While the pleasure experienced immediately following exercise has not been linked to future exercise behavior, a systematic review by Rhodes and Kates (2015) suggests that the greater pleasure experienced *during* exercise may increase future exercise participation. Further, the present study indicates that enjoyment and remembered pleasure – both retrospective evaluations and theoretical predictors of whether exercise should be repeated or avoided (Kahneman, Wakker, & Sarin, 1997; Zenko, Ekkekakis, & Ariely, 2016) – can be enhanced with verbal prompts to maximize pleasure during exercise.

Prompts Enhance Affective Valence

Differences in affective valence between conditions reached or approached statistical significance during the latter-half of the exercise session (minutes 6, 8, and 10), with small-to-medium effect sizes. The actual difference in FS responses ranged, on average, between 0.64 units and 0.69 units during minutes 6, 8, and 10. We do not know the practical meaning of these results for the present study. Researchers have linked a one-unit difference in FS responses during exercise to a change of 15 minutes per week of physical activity longitudinally (Williams et al., 2012). This prior evidence suggests that the differences observed in the present study might be associated with several additional minutes of physical activity per week. However, there are several important differences between the present study and the previous research by Williams and colleagues (2012), which makes direct comparison difficult. First, the present study was experimental, whereas the study by Williams and colleagues measured affective responses to treadmill walking between 2 and 4 miles per hour, with no experimental manipulation related to altering intensity or maximizing pleasure. Second, the association between a one-unit difference on the FS and future physical activity was found in a between-subjects analysis in the research by Williams et al. (2012). Here, we observed differences ranging from 0.64 units to 0.69 units in a within-subjects design. Third, there may have been ceiling effects of increased pleasure associated with prompts, since the control condition in the present study also consisted of self-selected exercise intensity. Previous literature has shown that self-selected exercise intensity is associated with pleasant affective responses (Haile et al., 2019; Lind, Ekkekakis, & Vazou, 2008; Sheppard & Parfitt, 2008). Thus, it is reasonable to expect smaller differences in the present study. Taken together, the evidence provided by Williams et al. (2012) suggests that the increase in affective valence observed in the present study may result in increased exercise behavior; however, methodological differences prevent direct comparison. Future researchers would need to measure exercise adherence to determine if prompts to maximize pleasure and enjoyment result in increased exercise behavior.

Importantly, the magnitude of the condition differences in affective valence grew as time progressed. These results suggest that participants do not automatically maximize their pleasure and enjoyment by default (i.e., without additional reminders to do so) and that pleasure prompts may have the greatest impact on during-exercise affective valence during the middle and latter half of a short exercise session. More research is needed to determine whether or not the benefits of pleasure prompts are greater during longer bouts of exercise (e.g., 30 minutes or one hour).

Potential Causal Mechanisms

Although the experimental manipulations altered participants' affective experience of exercise, these effects were not due to differences in exercise intensity. RPE and HR did not differ significantly between conditions. Thus, we are unable to attribute the differences in experienced pleasure, postexercise pleasure, remembered pleasure, and remembered enjoyment to differences in intensity, as indicated by HR and RPE. This finding was an unexpected, given the theoretical link between pleasure and intensity described previously (for review, see Ekkekakis et al., 2011). On the other hand, the self-selected nature of the intensity in the present study may explain the lack of difference between conditions. Ekkekakis (2009) noted that most individuals choose an intensity that is associated with physiological benefits and, "(at least in the presence of an investigator), most individuals raise their intensity up to the highest level that permits the maintenance of a positive affective steady state" (p. 879). Indeed, participants in the present study chose an intensity within the range recommended by the American College of Sports Medicine (i.e., 64-76% maximum heart rate corresponds to "moderate-intensity"; Garber et al., 2011), regardless of condition. In short, participants chose intensities that could elicit meaningful physiological benefits while still allowing for a positive affective experience. This finding could address concerns that prompting exercisers to maximize pleasure and enjoyment would result in exercise intensity that is "too light" and not likely to be health-enhancing.

Differences in perceived control and autonomy may explain why the Prompt condition altered participants' affective experience compared to the Control condition, without altering participants' self-selected exercise intensity. It is possible that the Prompt condition induced a greater sense of autonomy by reminding participants that they could change their exercise intensity. Increased perceived control and autonomy could have resulted in greater remembered pleasure, enjoyment, and postexercise pleasure. Vazou-Ekkekakis and Ekkekakis (2009) found that allowing participants to self-select their own intensity resulted in greater perceived autonomy and improved energetic arousal (but not greater affective valence as measured using the FS, the same dimensional measure used in the present study). In the present study, however, we did find that reminding participants that they could change the exercise intensity resulted in greater affective valence, potentially highlighting the important role of reminders in increasing pleasure. Methodological differences between the present study and Vazou-Ekkekakis and Ekkekakis (2009) leave open the possibility that reminding participants of their control over self-selected intensities (rather than simply allowing participants to choose their intensity in the absence of reminders) may impact feelings of pleasure-displeasure. However, lack of measurement of perceived control and autonomy in the present study makes it difficult to attribute the more positive affective experience of the Prompt condition to differences in autonomy and perceived control. These potential mechanisms can be explored by future researchers.

Limitations of the study design may also explain the effects of the experimental manipulations. For instance, the experimenter interacted with participants in the Prompt condition more frequently than in the Control, in order to deliver the reminders to maximize pleasure and enjoyment. Previous research has shown that frequency of social interaction is positively related to affect (Berry & Hansen, 1996). Therefore, it is possible that increased social interaction could explain some of the observed differences in pleasure and enjoyment between conditions. Future researchers can address this limitation by using pre-recorded audio reminders without depending on human interaction. Likewise, future researchers can control for participant-experimenter interaction by increasing interaction during the control condition. For example, participants in both conditions could be reminded that they can change the exercise intensity at any time, but pleasure would only be emphasized in one of the conditions. Relatedly, we cannot rule out experimenter demand effects, which created a potential limitation of the study: no deception was used, so participants were likely aware that the Prompt condition was designed to create more pleasure, and they may have adjusted their ratings of the exercise session based on this expectation. Finally, participants may not have understood that they could change the intensity multiple times throughout the exercise session as this was not specifically emphasized in the instructions. This should have been emphasized along with the existing statements that the intensity selected was the choice of the participants.

Conclusions and Future Directions

This study highlights that it is possible to alter the affective experience of exercise without changing the intensity of the exercise session (as measured by HR and RPE); both conditions elicited an exercise intensity that is within the recommended range for health promotion by the American College of Sports Medicine (Garber et al., 2011). In this experiment, pleasure and enjoyment of an exercise session were not solely contingent on physical exertion (as measured by HR and RPE). Thus, psychological mechanisms (such as autonomy, control, and reappraisal of affective states), in conjunction with physiological variables, should be emphasized in research examining exercise enjoyment and potential impacts on future exercise behavior.

Second, future research should examine the role of prompts to increase pleasure and enjoyment over longer-duration exercise sessions. It is possible that a longer exercise session would have produced stronger effects – in this experiment, differences in affective valence between conditions emerged in the second half of the exercise session, compared to the first. In a longer exercise session, researchers should consider the ideal frequency of reminders (to avoid measurement fatigue and potential annoyance from frequent interruptions). Additional research is needed to test how longer bouts of exercise might impact affective responses and to determine the ideal frequency of during-exercise pleasure prompts.

Additionally, the experiment illustrates that using simple verbal prompts enhances participants' experience of exercise, which easily lends these findings to naturalistic field settings. Thus, future researchers could apply and test these interventions by creating orientation sessions designed to teach participants how to maximize their own pleasure. Focusing on breathing, heart rate, and RPE are common methods utilized, but training people to focus their attention on maximizing pleasure and enjoyment in the exercise context is less common and may also be beneficial, based on results from this experiment.

Finally, this experiment has important implications for the impact of pleasure on exercise behavior. Pleasure experienced during exercise predicts future exercise behavior (Rhodes & Kates, 2015). The prompts in this experiment also enhanced enjoyment, remembered pleasure, and postexercise pleasure. It is possible that prompts that experimentally increase pleasure might also influence future exercise intentions or exercise behavior itself. Thus, extensions of this work should measure the effect of momentary pleasure reminders and transient increases in pleasure on long-term exercise behavior.

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Table 1: Means and Standard Deviations for Affective Valence, Remembered Enjoyment, Remembered Pleasure, Heart Rate, and Perceived Exertion

	Prompt Condition		Control Condition	
	M	SD	M	SD
Affective Valence				
Pre-exercise	2.51	1.72	2.59	1.79
Minute 2	2.41	1.53	2.36	1.51
Minute 4	2.46	1.52	2.21	1.36
Minute 6	2.95	1.23	2.26	1.50
Minute 8	2.77	1.60	2.13	1.72
Minute 10	2.77	1.60	2.13	1.51
Post-exercise	3.38	1.31	2.79	1.47
Remembered Enjoyment	5.19	0.83	4.95	0.86
Remembered Pleasure	78.50	15.10	67.25	20.51
Heart Rate				
Pre-exercise	47.66	7.70	48.47	7.032
Minute 2	63.23	8.16	64.04	10.01
Minute 4	65.83	9.53	67.48	10.62
Minute 6	67.00	10.84	69.08	12.24
Minute 8	68.49	12.03	70.28	13.13
Minute 10	69.51	12.92	69.97	13.67
Perceived Exertion				
Minute 2	11.33	1.63	11.26	1.67
Minute 4	11.85	1.83	12.10	1.54
Minute 6	11.60	2.17	12.41	1.86
Minute 8	12.08	2.23	12.90	1.90
Minute 10	12.23	2.49	12.51	2.01

Note. M = Mean. SD = Standard Deviation. Affective valence ranges from -5 (Very Bad) to +5 (Very Good). Remembered enjoyment ranges from 1 to 7. Remembered pleasure ranges from 0 (It was a very negative experience) to 100 (It was a very positive experience). Heart rate is presented as a percentage of age-predicted maximum. Rating of Perceived Exertion ranges from 6 to 20.

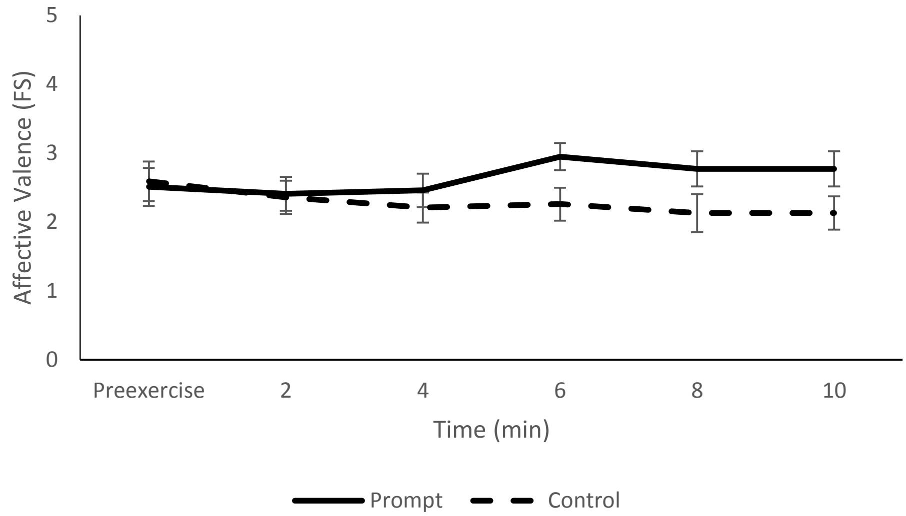

Figure 1. Affective valence over time during each condition. Standard error bars are shown for each time point.

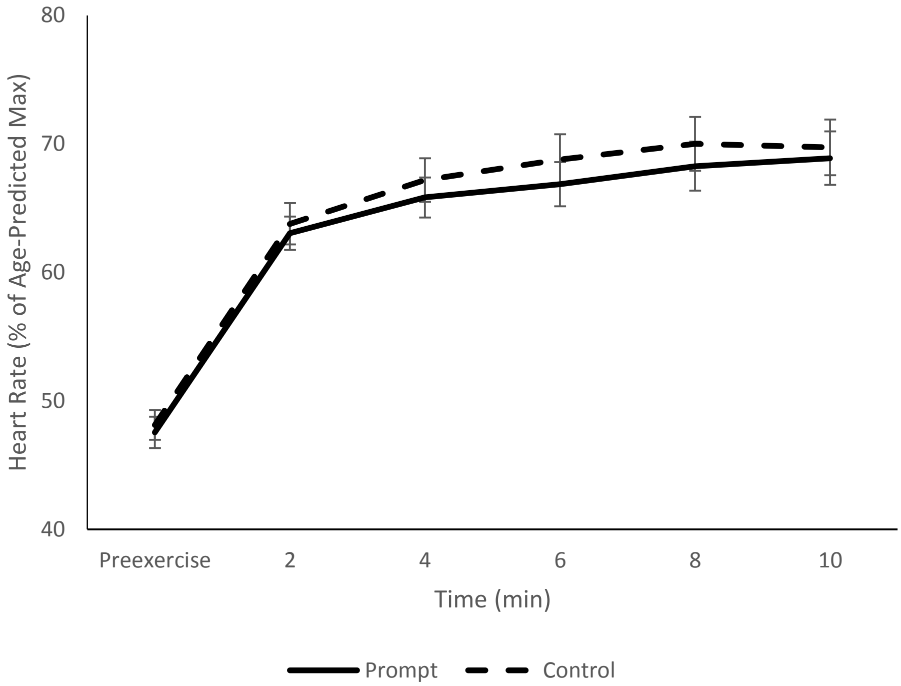

Figure 2. Heart rate over time during each condition. Standard error bars are shown for each time point.

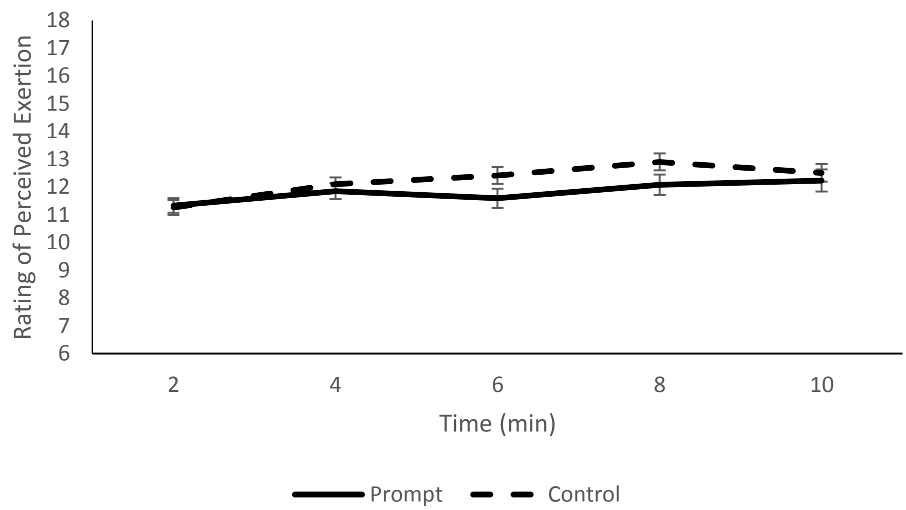

Figure 3. Ratings of Perceived Exertion over time during each condition. Standard error bars are shown for each time point.